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F AUSTRALIA

65, 947/60

PATENT SPECIFICATION

Complete Specification Lodged ..... 25th October, 1960.

Application Lodged (No. 65, 947/60) ..... 25th October, 1960.

Applicant..... United States Atomic Energy Commission.

Actual Inventors..... Walter C. Hayes and Robert W. Dickinson.

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Convention Application.
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International Classification C 22 c.
No drawing.

COMPLETE SPECIFICATION.

STEEL ALLOY COMPOSITION.

The following statement is a full description of this invention, including the best method of performing it known to us:

This invention relates to an improved high temperature alloy. More particularly, this invention relates to an improved high temperature steel alloy with low thermal coefficient of expansion, high thermal conductivity, and good high temperature mechanical properties.

Austenitic stainless steels are well known in the art. An example of a stainless steel is AISI type No. 304 which contains from 18% to 20% chromium and 8% to 11% nickel with 2% max. of manganese. It has a low carbon content and has many uses. However, it has some drawbacks, one of which is its relatively high cost because of the high chromium and nickel content. Also, its thermal coefficient of expansion is a little high for certain applications while its thermal conductivity is too low. On the other hand, ferritic steels have low coefficient of expansion and a high thermal conductivity as well as low cost, but they are weak at elevated temperatures. Consequently, it would be advantageous to obtain a ferritic alloy which would combine the conductivity and expansion properties of ferritic steels with the excellent strength properties of austenitic steels for use at high temperatures. For such application high thermal conductivity, low thermal coefficient of expansion and, therefore, low thermal stresses are important.

It is, therefore, an object of this invention to provide a new steel alloy having

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420/109

merely adding a small amount of niobium and titanium, the composition of the steel is improved with respect to stress to rupture by 152%. From Table II it is seen that the offset yield strength of the niobium-containing alloy of this invention is 124% higher than that of 2.25% chromium and 1% molybdenum ferritic steel and 150% higher than that of 304 stainless at room temperature; 147% higher than that of ferritic steel and 378% higher than that of stainless steel at 1050°F (565°C); and 206% higher than ferritic steel and 366% higher than stainless steel at 1200°F (650°C). It is also seen that the ultimate tensile strength of the niobium-containing steel is 35% higher than that of ferritic steel and 26% higher than that of stainless steel at room temperature; 41% higher than that of ferritic steel and 29% higher than that of stainless steel at 1050°F; and 82% higher than that of ferritic steel and 25% higher than that of stainless steel at 1200°F. From Table III it is also noted that the minimum creep rate of the niobium-containing steel of this invention is from about a factor of 2 to about a factor of 10 lower than for ferritic steel and from about a factor of 5 to about a factor of 10 lower than that of the 304 stainless steel. Thus components manufactured from the steel alloys of this invention will deform only at very slow rates when in highly stressed service at temperatures up to at least about 1100°F.

The steel alloy specimens of this invention used for the tests given in Tables II and III were 4 inches long with a 1.5 inch gauge length and a gauge diameter of 0.375 inch. The specimen steel alloys of this invention described in the Examples and in Table I, like the specimen used to illustrate the improvement in the properties listed in Tables II and III, all have properties which are an improvement over the ferritic and stainless steel compositions.

While the invention has been described with reference to specific steel alloy compositions, it is to be understood that this is by way of example only and not by way of limitation. The spirit and scope of the invention is to be limited only by the appended claims.

The claims defining the invention are as follows:-

1. An alloy containing

from 0.4%	to	7.5% chromium
from 0.4%	to	4% molybdenum
from 0.05%	to	0.4% carbon
from 0.1%	to	1.5% manganese
from 0.1%	to	1% niobium
from 0%	to	1.4% titanium
from 0%	to	4% nickel

and the remainder substantially iron. (2nd November, 1959).

2. An alloy containing

from 0.4%	to	7.5% chromium
from 0.4%	to	4% molybdenum
from 0.05%	to	0.4% carbon
from 0.1%	to	1.5% manganese
from 0.1%	to	1% niobium
from 0%	to	1.4% titanium
from 0%	to	4% nickel

0.1% (max.) boron
0.02% (max.) nitrogen
0.2% (max.) aluminum